

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (currently amended) In a disk drive that includes A driver having a current control device for a head, a disk, a microprocessor, a driver and a voice coil motor, wherein the head reads from and writes to the disk, the microprocessor provides a command current to the driver, the driver provides a coil current to the voice coil motor in response to the command current, the
5 voice coil motor radially positions the head relative to the disk in response to the coil current, and the coil current flows through a coil in the voice coil motor in a disk drive, the driver
comprising:

a sensor that provides a sense current by sensing to sense the a coil current in said voice coil motor;

10 a comparator that provides transeconductance amplifier to detect an error current by determining a difference between by comparing the command said coil current and thea sense command current; and

an integrator that provides an integrated error current by integrating the -compensator to integrate said error current; and

15 an amplifier that provides the coil current by amplifying the integrated error current into said coil current.

2. (currently amended) The driver of claim 1, wherein the sensor includes a sense resistor that provides a sense voltage in response to the coil current and a transconductance amplifier that

provides the sense current in response to the sense voltage ~~further comprising a force couple~~
~~created by said current in said voice coil motor wherein a first coil motor and a second coil motor~~
5 ~~of the voice coil motor are oppositely polarized to induce magnetic fields in opposite directions.~~

3. (currently amended) The driver of claim 1, wherein the coil includes first and second
coils and a center tap, the amplifier includes first and second amplifiers, the first amplifier is
coupled to the first coil, the second amplifier is coupled to the second coil and the first and
second coils are coupled to one another at the center tap ~~further comprising a current sense~~
5 ~~amplifier coupled to said transconductance amplifier to amplify a voltage across said sensor.~~

4. (currently amended) The driver of claim 3, wherein the first and second coils are
coupled in series between the first and second amplifiers ~~1, wherein said voice coil motor~~
~~includes a first coil motor and a second coil motor that are energized to retract a head positioner.~~

5. (currently amended) The driver of claim 4, wherein the first amplifier is coupled to the
second coil and the center tap through the first coil, and the second amplifier is coupled to the
first coil and the center tap through the second coils ~~said first coil motor and said second coil~~
~~motor are coupled in series such that said coil current flows through both coil motors.~~

6. (currently amended) The driver of claim 1, wherein the integrator ~~said compensator~~
includes a capacitor.

7. (currently amended) The driver of claim 6, wherein the capacitor is coupled to a node between the comparator and the amplifier~~said compensator includes a resistor.~~

8. (currently amended) The driver of claim 7, wherein a resistor is coupled to the node by the capacitor, and the resistor provides a phase shift in the integrated error current that cancels a phase shift due to the voice coil motor~~1, further comprising a driver amplifier to supply said coil current, said driver amplifier coupled to said compensator.~~

9. (currently amended) The driver of claim 1, wherein the microprocessor sends a digital command to a digital-to-analog converter, the digital-to-analog converter provides an analog command in response to the digital command and the analog command provides the command current~~said sensor includes a sense resistor.~~

10. (currently amended) The driver of claim 1, wherein the microprocessor provides the command current in response to a host computer~~said command current is received at said driver from a microcontroller.~~

11. (currently amended) The driver of claim 1, wherein the microprocessor provides the command current in response to a servo operation~~further comprising said compensator coupled to said transconductance amplifier, said compensator including a capacitor.~~

12. (currently amended) The driver of claim 1, wherein the microprocessor provides the command current in response to a track following operation~~said transconductance amplifier~~

includes a first input and a second input, such that said coil current is coupled to the first input of the transconductance amplifier, and said command current is coupled to the second input of the transconductance amplifier, wherein the transconductance amplifier detects said error current by determining the difference between the coil current and the command current.

13. (currently amended) The driver of claim 1, wherein the microprocessor provides the command current in response to a retract operation~~11~~, wherein said compensator is coupled to a gain buffer.

14. (currently amended) A method for controlling tracking a disk using a voice coil motor in the disk drive~~coupled to a driver~~, wherein the disk drive includes a head, a disk and the voice coil motor, the head reads from and writes to the disk, the voice coil motor radially positions the head relative to the disk in response to a coil current, and the coil current flows through a coil in the voice coil motor, the method comprising:

providing a command current that controls the voice coil motor;

sensing the a-coil current to provide a sense current~~in said voice coil motor;~~

comparing the command current and the sense current to provide ~~determining an error current as a difference between the command current and the sense current by comparing said coil current and a command current using a transconductance amplifier; and~~

integrating the said-error current to provide an integrated error current~~into said coil current; and then~~

amplifying the integrated error current to provide the coil current.

15. (currently amended) The method of claim 14, including providing the command current in response to a track following operation~~further comprising amplifying said coil current.~~

16. (currently amended) The method of claim 14, including sensing the coil current to provide a sense voltage and converting the sense voltage into the sense current~~further comprising receiving said command current at said driver.~~

17. (currently amended) The method of claim 14, including integrating the error current using a capacitor~~further comprising inducing a magnetic field in said voice coil motor.~~

18. (currently amended) The method of claim 14, including amplifying the integrated error current using a class AB amplifier~~wherein said sensing step includes sensing a voltage and determining said coil current from said voltage.~~

19-20. (cancelled)

21. (currently amended) The method of claim 14, including amplifying the integrated error current using first and second amplifiers coupled to first and second coils in the voice coil motor~~wherein said determining step includes comparing said coil current and said command current at said transconductance amplifier.~~

22. (currently amended) The method of claim 14, ~~further including~~ phase shifting
~~compensating for said error current by delaying said integrating the integrated error current using~~
a resistor~~step~~.

23. (currently amended) In a disk drive that includes a head, a disk, a microprocessor, a
driver and a voice coil motor, wherein the head reads from and writes to the disk, the
microprocessor provides a command current to the driver, the driver provides a coil current to
the voice coil motor in response to the command current, the voice coil motor radially positions
5 the head relative to the disk in response to the coil current, and the coil current flows through a
coil in the voice coil motor, the driver~~A current control device for a voice coil motor driver, said~~
~~voice coil motor driver coupled to a microprocessor to receive commands specifying a command~~
~~current for a voice coil motor, comprising:~~

a sensor resistor that provides a sense voltage by sensing the coil current;

10 a transconductance amplifier that provides a sense current in response to the sense
voltage;

a comparator that provides an error current by determining a difference between the
command current and the sense current;

an integrator that provides an integrated error current by integrating the error current
15 using a capacitor; and

an amplifier that provides the coil current by amplifying the integrated error current~~an~~
~~amplifier to drive said voice coil motor with a coil current; and~~

20 ~~_____ a compensator circuit to integrate an error current with said command current to generate
said coil current, wherein said error current is detected by comparing said command current and
said coil current sensed with a sensor coupled between said amplifier and said voice coil motor.~~

5 24. (currently amended) The driver current control device of claim 23, wherein the coil
includes first and second coils and a center tap, the amplifier includes first and second amplifiers,
the first amplifier is coupled to the first coil, the second amplifier is coupled to the second coil
and the first and second coils are coupled to one another at the center tap~~further comprising a
transconductance amplifier to detect and calculate said error current by comparing said command
current and said coil current.~~

25. (currently amended) The driver current control device of claim 24, wherein the first
and second coils are coupled in series between the first and second amplifiers~~23, wherein said
error current correlates to a voltage across said sensor.~~

26. (currently amended) The driver current control device of claim 25, wherein the first
amplifier is coupled to the second coil and the center tap through the first coil, and the second
amplifier is coupled to the first coil and the center tap through the second coil~~23, wherein said
sensor is a resistor.~~

27. (currently amended) The driver current control device of claim 26, wherein the first
amplifier is coupled to the first coil by a first terminal, the second amplifier is coupled to the
second coil by a second terminal and the driver is coupled to the center tap by a third terminal~~23,~~

5 ~~further comprising a current sense amplifier coupled between said sensor and said compensator~~
~~to amplify a voltage across said sensor.~~

28. (currently amended) ~~The driver current control device of claim 27, wherein an~~
~~interface between the driver and the voice coil motor consists of the first, second and third~~
~~terminals~~²³~~, wherein said amplifier is coupled to a set of transistors to provide said coil current.~~

29. (currently amended) In a disk drive that includes a head, a disk, a microprocessor, a
driver and a voice coil motor, wherein the head reads from and writes to the disk, the
microprocessor provides a command current to the driver, the driver provides a coil current to
the voice coil motor in response to the command current, the voice coil motor radially positions
5 the head relative to the disk in response to the coil current, the coil current flows through a coil in
the voice coil motor, the coil includes first and second coils and a center tap, and the first and
second coils are coupled to one another at the center tap, the driver comprising:

a sensor that provides a sense current by sensing the coil current;

10 a comparator that provides an error current by determining a difference between the
command current and the sense current;

an integrator that provides an integrated error current by integrating the error current; and

an amplifier that provides the coil current by amplifying the integrated error current,
wherein the amplifier includes first and second amplifiers, the first amplifier is coupled to the
first coil by a first terminal, the second amplifier is coupled to the second coil by a second
15 terminal, the first amplifier is coupled to the second coil and the center tap through the first coil,
the second amplifier is coupled to the first coil and the center tap through the second coil, the

driver is coupled to the center tap by a third terminal, and an interface between the driver and the voice coil motor consists of the first, second and third terminals~~A driver having a current control device for a voice coil motor, comprising:~~

- 20 ~~—— an amplifier to drive said voice coil motor with a coil current, said coil current flows from one terminal of said voice coil motor to another terminal, wherein both terminals are coupled to said driver;~~
- ~~—— a sensor to sense said coil current in said voice coil motor, wherein said sensor is coupled between said amplifier and said voice coil motor;~~
- 25 ~~—— a current sense amplifier to amplify a voltage across said sensor, wherein said voltage correlates to said coil current;~~
- ~~—— a transconductance amplifier coupled to said current sense amplifier to receive said voltage and a command current, wherein said transconductance amplifier calculates an error current by comparing the sense current with the command current;~~
- 30 ~~—— an integrator coupled to said transconductance amplifier to integrate said error current into said command current to determine said coil current.~~

30. (currently amended) In a disk drive that includes a head, a disk, a microprocessor, a driver and a voice coil motor, wherein the head reads from and writes to the disk, the microprocessor provides a command current to the driver, the driver provides a coil current to the voice coil motor in response to the command current, the voice coil motor radially positions the head relative to the disk in response to the coil current, the coil current flows through a coil in the voice coil motor, the coil includes first and second coils and a center tap, and the first and second coils are coupled to one another at the center tap, the driver comprising:

a sensor that provides a sense current by sensing the coil current;

a comparator that provides an error current by determining a difference between the

10 command current and the sense current;

an integrator that provides an integrated error current by integrating the error current;

first and second amplifiers that provide the coil current by amplifying the integrated error

current, wherein the first amplifier is coupled to the first coil, the second amplifier is coupled to

the second coil, the first amplifier is coupled to the second coil and the center tap through the

15 first coil, and the second amplifier is coupled to the first coil and the center tap through the

second coil; and

first and second transistors coupled to the center tap and coupled to the first and second

coils through the center tap.~~A driver having a current controller for a voice coil motor in a seek~~

~~mode, comprising:~~

20 ~~—— a set of transistors coupled to said voice coil motor by a center tap, said set of transistors~~

~~to supply a coil current having a waveform to said center tap;~~

~~—— a current sense amplifier to detect said coil current;~~

~~—— a comparator to shape a command current waveform to said coil current waveform; and~~

~~—— a bipolar switch control to receive said command current waveform and to saturate said~~

25 ~~set of transistors.~~

31. (currently amended) The driver of claim 30, wherein the first and second amplifiers

send the coil current through the first and second coils in series, the first and second transistors

are turned off and the center tap floats in response to a track following operation.~~said voice coil~~

~~motor includes a first coil motor and a second coil motor coupled to said center tap.~~

32. (currently amended) The driver of claim 31, wherein the first and second amplifiers operate as a class AB amplifier in response to the track following operations~~said first coil has a first current and said second coil motor has a second current.~~

33. (currently amended) The driver of claim 30, wherein the first transistor sends the coil current through the center tap in a first direction, sends a first portion of the coil current through the first coil and sends a second portion of the coil current through the second coil, and the first and second amplifiers and the second transistor are turned off in response to a first seek operation that moves the head across the disk in a first radial direction~~32, wherein said coil current is the sum of said first current and said second current.~~

34. (currently amended) The driver of claim 33, wherein the second transistor sends the coil current through the center tap in a second direction opposite the first direction, sends a first portion of the coil current through the first coil and sends a second portion of the coil current through the second coil, and the first and second amplifiers and the first transistor are turned off in response to a second seek operation that moves the head across the disk in a second radial direction opposite the first radial direction~~30, when said set of transistors includes a first transistor and a second transistor.~~

35. (currently amended) The driver of claim 34, wherein the coil current is independent of the integrated error current during the first and second seek operations~~30, wherein said set of transistors includes dynamic MOS transistors.~~

36. (currently amended) The driver of claim 35, wherein the first transistor sends the coil
current through the center tap in the first direction, sends a first portion of the coil current
through the first coil and sends a second portion of the coil current through the second coil, the
first and second amplifiers and the second transistor are turned off and the coil current is based
5 on the integrated error current in response to a retract operation that moves the head across the
disk in the first radial direction~~30, wherein said command current waveform has a duty cycle~~
~~such that said bipolar switch control is turned on and off according to said duty cycle.~~

37. (currently amended) The driver of claim 30, wherein the first amplifier is coupled to
the first coil by a first terminal, the second amplifier is coupled to the second coil by a second
terminal, the first and second transistors are coupled to the center tap by a third terminal, and an
interface between the driver and the voice coil motor consists of the first, second and third
5 terminals~~said command current is received from a microcontroller.~~

38. (currently amended) A method for controlling a voice coil motor in the disk drive,
wherein the disk drive includes a head, a disk and the voice coil motor, the head reads from and
writes to the disk, the voice coil motor radially positions the head relative to the disk in response
to a coil current, the coil current flows through a coil in the voice coil motor, the coil includes
5 first and second coils and a center tap, and the first and second coils are coupled to one another at
the center tap, the method comprising:

providing a command current that controls the voice coil motor;

sensing the coil current to provide a sense current;

- comparing the command current and the sense current to provide an error current as a
10 difference between the command current and the sense current;
integrating the error current to provide an integrated error current; then
amplifying the integrated error current to provide the coil current; and
sending the coil current through the first and second coils in series while the center tap
floats~~A method for controlling a voice coil motor accessing a track on a magnetic disk with a~~
15 ~~driver, comprising:~~
~~—— supplying a coil current to said voice coil motor;~~
~~—— amplifying said coil current; and~~
~~—— shaping a command current waveform according to said coil current.~~

39. (currently amended) The method of claim 38, including sending the coil current
through the first and second coils in series while the center tap floats using a class AB
amplifier~~further comprising receiving said command current waveform at a bipolar switch~~
~~control.~~

40. (currently amended) The method of claim 38, including sending the coil current
through the first and second coils in series while the center tap floats in response to a track
following operation~~39, further comprising saturating a set of transistors coupling said bipolar~~
~~switch with said voice coil motor.~~

41. (currently amended) The method of claim 40, including sending the coil current through the center tap and through the first and second coils in parallel in response to a seek operation~~40, further comprising turning said transistors on and off with said bipolar switch.~~

42. (currently amended) The method of claim 41, including sending the coil current through the first and second coils in parallel such that about one-half the coil current flows through the first coil and about one-half the coil current flows through the second coil in response to the seek operation~~38, wherein said supplying step includes supplying said coil current to a center tap coupling said voice coil motor to said driver.~~

43. (currently amended) The method of claim 41, including sending the coil current through the center tap and through the first and second coils in parallel using the integrated error current in response to a retract operation~~38, wherein said amplifying step comprises amplifying said coil current with a current sense amplifier.~~

44. (currently amended) In a disk drive that includes a head, a disk, a microprocessor, a driver and a voice coil motor, wherein the head reads from and writes to the disk, the microprocessor provides a command current to the driver, the driver provides a coil current to the voice coil motor in response to the command current, the voice coil motor radially positions the head relative to the disk in response to the coil current, the coil current flows through a coil in the voice coil motor, the coil includes first and second coils and a center tap, and the first and second coils are coupled to one another at the center tap, the driver comprising:
a sensor resistor that provides a sense voltage by sensing the coil current;

a transconductance amplifier that provides a sense current in response to the sense
 10 voltage;
a comparator that provides an error current by determining a difference between the
command current and the sense current;
an integrator that provides an integrated error current by integrating the error current
using a capacitor;
 15 first and second amplifiers that provide the coil current by amplifying the integrated error
current in response to a track following operation, wherein the first amplifier is coupled to the
first coil, the second amplifier is coupled to the second coil, the first amplifier is coupled to the
second coil and the center tap through the first coil, and the second amplifier is coupled to the
first coil and the center tap through the second coil; and
 20 first and second transistors that provide the coil current independently of the integrated
error current in response to first and second seek operations, wherein the first and second
transistors are coupled to the center tap and coupled to the first and second coils through the
center tap~~A current control device within a driver for controlling a voice coil motor to seek a~~
~~track on a storage media, comprising:~~
 25 ~~—— a coil current supplied to said voice coil motor along a center tap coupled to said driver;~~
~~and~~
~~—— a comparator to shape a waveform of a specified command current in accordance with a~~
~~waveform of said coil current, wherein said command current drives a bipolar switch coupled to~~
~~said center tap.~~

45. (currently amended) The driver current control device of claim 44, wherein the first and second amplifiers operate as a class AB amplifier and send the coil current through the first and second coils in series, the first and second transistors are turned off and the center tap floats in response to the track following operation further comprising a current sense amplifier to detect
5 said coil current within said voice coil motor.

46. (currently amended) The driver current control device of claim 44, wherein the first transistor sends the coil current through the center tap in a first direction and the first and second amplifiers and the second transistor are turned off in response to the first seek operation that moves the head across the disk in a first radial direction, and the second transistor sends the coil
5 current through the center tap in a second direction opposite the first direction and the first and second amplifiers and the first transistor are turned off are turned off in response to the second seek operation that moves the head across the disk in a second radial direction opposite the first radial direction further comprising a set of transistors coupled to said bipolar switch and said center tap, wherein said set of transistors are turned on and off to supply current to said center
10 tap.

47. (currently amended) The driver current control device of claim 44, wherein the first amplifier is coupled to the first coil by a first terminal, the second amplifier is coupled to the second coil by a second terminal, the first and second transistors are coupled to the center tap by a third terminal, and an interface between the driver and the voice coil motor consists of the first,
5 second and third terminals said center tap supplies a first coil motor current and a second coil

~~motor current to a first coil motor and a second coil motor within said voice coil motor, such that coil current is about equal to the sum of said first coil current and said second coil current.~~

48. (currently amended) In a disk drive that includes a head, a disk, a microprocessor, a driver and a voice coil motor, wherein the head reads from and writes to the disk, the microprocessor provides a command current to the driver, the driver provides a coil current to the voice coil motor in response to the command current, the voice coil motor radially positions the head relative to the disk in response to the coil current, the coil current flows through a coil in the voice coil motor, the coil includes first and second coils and a center tap, and the first and second coils are coupled to one another at the center tap, the driver comprising:

a sensor that provides a sense current by sensing the coil current;

a comparator that provides an error current by determining a difference between the command current and the sense current;

an integrator that provides an integrated error current by integrating the error current;

first and second amplifiers that provide the coil current by amplifying the integrated error current in response to a track following operation, wherein the first amplifier is coupled to the first coil, the second amplifier is coupled to the second coil, the first amplifier is coupled to the second coil and the center tap through the first coil, and the second amplifier is coupled to the first coil and the center tap through the second coil; and

first and second transistors coupled to the center tap and coupled to the first and second coils through the center tap that provide the coil current independently of the integrated error current in response to first and second seek operations, wherein the first and second amplifiers operate as a class AB amplifier and send the coil current through the first and second coils in

series, the first and second transistors are turned off and the center tap floats in response to the track following operation, the first transistor sends the coil current through the center tap in a first direction and through the first and second coils in parallel to divide the coil current between the first and second coils and the first and second amplifiers and the second transistor are turned off in response to the first seek operation that moves the head across the disk in a first radial direction, and the second transistor sends the coil current through the center tap in a second direction opposite the first direction and through the first and second coils in parallel to divide the coil current between the first and second coils and the first and second amplifiers and the first transistor are turned off in response to the second seek operation that moves the head across the disk in a second radial direction opposite the first radial direction. A driver having a current control device for controlling a voice coil motor during a seek mode, comprising:

- a current sense amplifier to detect a coil current within said voice coil motor, wherein said coil current is supplied by a center tap coupled to said driver and said voice coil motor;
- a current command to specify a command current having a waveform;
- a comparator coupled to said current sense amplifier to receive said current command and shape said command current waveform according to a waveform of said coil current;
- a bipolar switch coupled to said comparator to turn on and off a set of transistors to supply said command current to said center tap.

49. (currently amended) The driver of claim 48, wherein the first transistor is turned on and off using pulse width modulation that is active while the coil current is less than a threshold based on the command current and is inactive for a predetermined time period in response to the first seek operation, and the second transistor is turned on and off using pulse width modulation

5 that is active while the coil current is less than the threshold and is inactive based for the
predetermined time period in response to the second seek operations~~said set of transistors~~
~~comprises dynamic MOS transistors.~~

50. (currently amended) In a disk drive that includes a head, a disk, a microprocessor, a
driver, a voice coil motor and a ramp, wherein the head reads from and writes to the disk, the
microprocessor provides a command current to the driver, the driver provides a coil current to
the voice coil motor in response to the command current, the voice coil motor radially positions
5 the head relative to the disk in response to the coil current during a track following operation and
retracts the head from the disk and loads the head on the ramp in response to the coil current
during a retract operation, and the coil current flows through a coil in the voice coil motor, the
driver comprising:

a sensor that provides a sense current sensing the coil current;
10 a comparator that provides an error current by determining a difference between the
command current and the sense current;
an integrator that provides an integrated error current by integrating the error current;
an amplifier that provides the coil current by amplifying the integrated error current in
response to the track following operation; and

15 a transistor that provides the coil current based on the integrated error current in response
to the retract operation~~A driver for controlling a voice coil motor during a retract mode, said~~
~~voice coil motor having a first coil motor and second coil motor, comprising:~~
~~—— a sensor to sense a velocity voltage across said second coil motor;~~

~~an error amplifier to calculate a differential between said velocity voltage and a command~~

20 ~~voltage; and~~

~~a retract amplifier to compensate said command voltage with said differential.~~

51. (currently amended) The driver of claim 50, wherein the sensor includes a sense resistor that provides a sense voltage in response to the coil current and a transconductance amplifier that provides the sense current in response to the sense voltage~~further comprising a differential amplifier coupled to said error amplifier, wherein said differential amplifier detects~~
5 ~~said velocity voltage across said sensor.~~

52. (currently amended) The driver of claim 50, wherein the integrator includes a capacitors~~said retract amplifier is coupled to said compensator, wherein said retract amplifier drives said first coil motor at said command voltage.~~

53. (currently amended) The driver of claim 50, wherein the coil includes first and second coils and a center tap, the amplifier includes first and second amplifiers, the first amplifier is coupled to the first coil, the second amplifier is coupled to the second coil, the first amplifier is coupled to the second coil and the center tap through the first coil, and the second amplifier is
5 coupled to the first coil and the center tap through the second coil~~52, wherein said retract amplifier receives said command voltage from said compensator, and supplies a current to said first coil motor.~~

54. (currently amended) The driver of claim 53, wherein the transistor is coupled to the center tap and is coupled to the first and second coils through the center tap~~52, further comprising a set of transistors coupled to said retract amplifier.~~

55. (currently amended) The driver of claim 54, wherein the first amplifier is coupled to the first coil by a first terminal, the second amplifier is coupled to the second coil by a second terminal, the transistor is coupled to the center tap by a third terminal, and an interface between the driver and the voice coil motor consists of the first, second and third terminals~~50, wherein~~
5 ~~said first coil motor comprises coil windings.~~

56. (currently amended) The driver of claim 50, wherein the amplifier provides the coil current independently of the transistor during the track following operation, and the transistor provides the coil current independently of the amplifier during the retract operations~~said second coil motor comprises coil windings.~~

57. (currently amended) The driver of claim 50, wherein the transistor provides the coil current independently of the comparator and the integrator during a seek operations~~said retract amplifier is turned on and off.~~

58. (currently amended) A method for controlling a voice coil motor in the disk drive, wherein the disk drive includes a head, a disk, a ramp and the voice coil motor, the head reads from and writes to the disk, the voice coil motor radially maintains the head relative to the disk in response to a coil current during a track following operation, the voice coil motor radially

- 5 moves the head relative to the disk in response to the coil current during a seek operation, the voice coil motor retracts the head from the disk and loads the head on the ramp in response to the coil current during a retract operation, and the coil current flows through a coil in the voice coil motor, the method comprising:
- providing a command current that controls the voice coil motor;
- 10 sensing the coil current to provide a sense current;
- comparing the command current and the sense current to provide an error current as a difference between the command current and the sense current;
- integrating the error current to provide an integrated error current;
- providing the coil current using the integrated error current in response to the track
- 15 following operation;
- providing the coil current using the integrated current in response to the retract operation;
- and
- providing the coil current without using the integrated error current in response to the seek operation
- 20 ~~A method for controlling a voice coil motor having a first coil motor and a second coil motor with a driver during a retract mode, comprising:~~
- ~~—detecting a velocity voltage with said second coil motor;~~
- ~~—determining a differential voltage between said velocity voltage and a command voltage;~~
- ~~and~~
- ~~—compensating said command voltage with said differential voltage.~~

59. (currently amended) The method of claim 58, including sensing the coil current to provide a sense voltage and converting the sense voltage into the sense current~~wherein said detecting step includes using a differential amplifier coupled to said second coil motor.~~

60. (currently amended) The method of claim 58, including integrating the error current using a capacitor~~further comprising applying a current correlating to said command voltage to said first coil motor.~~

61. (currently amended) The method of claim 58, including performing the track following and seek operations in response to a servo operation~~wherein said compensating step includes using a retract amplifier coupled to said voice coil motor.~~

62. (currently amended) The method of claim 58, including performing the retract operation in response to powering down the disk drive~~61, further comprising saturating a set of transistors to supply a current from said retract amplifier to said voice coil motor.~~

63-101. (cancelled)

102. (new) In a disk drive that includes a head, a disk, a microprocessor, a driver and a voice coil motor, wherein the head reads from and writes to the disk, the microprocessor provides a command current to the driver, the driver provides a coil current to the voice coil motor in response to the command current, the voice coil motor radially positions the head
5 relative to the disk in response to the coil current, the coil current flows through a coil in the

voice coil motor, the coil includes first and second coils and a center tap, and the first and second coils are coupled to one another at the center tap, the driver comprising:

a sensor that provides a sense current by sensing the coil current;

a comparator that provides an error current by determining a difference between the

10 command current and the sense current;

an integrator that provides an integrated error current by integrating the error current;

an amplifier that provides the coil current through the first and second coils in series

while the center tap floats by amplifying the integrated error current in response to a track following operation; and

15 a transistor that provides the coil current through the center tap such that the coil current is divided between and flows in parallel through the first and second coils in response to a seek operation.

103. (new) The driver of claim 102, wherein the amplifier operates as a class AB amplifier during the track following operation.

104. (new) The driver of claim 102, wherein the transistor operates as a saturated bore transistor during the seek operation.

105. (new) The driver of claim 102, wherein the amplifier is turned off during the seek operation.

106. (new) The driver of claim 102, wherein the transistor is turned off during the track following operation.

107. (new) The driver of claim 102, wherein the first and second coils provide opposing rotational forces in opposite rotational directions during the track following operation.

108. (new) The driver of claim 102, wherein the first and second coils provide additive rotational forces in the same rotational direction during the seek operation.

109. (new) The driver of claim 102, wherein the coil current is divided between the first and second coils during the seek operation such that about one-half the coil current flows through the first coil and about one-half the coil current flows through the second coil.

110. (new) The driver of claim 102, wherein the transistor provides the coil current without using the integrated error current in response to the seek operation, and the transistor provides the coil current using the integrated error current in response to a retract operation.

111. (new) The driver of claim 102, wherein the amplifier is coupled to the first coil by a first terminal, the amplifier is coupled to the second coil by a second terminal, the transistor is coupled to the center tap by a third terminal, and an interface between the driver and the voice coil motor consists of the first, second and third terminals.

112. (new) In a disk drive that includes a head, a disk, a microprocessor, a driver and a voice coil motor, wherein the head reads from and writes to the disk, the microprocessor provides a command current to the driver, the driver provides a coil current to the voice coil motor in response to the command current, the voice coil motor radially positions the head relative to the disk in response to the coil current, the coil current flows through a coil in the voice coil motor, the coil includes first and second coils and a center tap, and the first and second coils are coupled to one another at the center tap, the driver comprising:

a sensor resistor that provides a sense voltage by sensing the coil current;

a transconductance amplifier that provides a sense current in response to the sense voltage;

a comparator that provides an error current by determining a difference between the command current and the sense current;

an integrator that provides an integrated error current by integrating the error current using a capacitor;

an amplifier that provides the coil current through the first and second coils in series while the center tap floats by amplifying the integrated error current in response to a track following operation; and

a transistor that provides the coil current through the center tap such that the coil current is divided between and flows in parallel through the first and second coils in response to a seek operation.

113. (new) The driver of claim 112, wherein the amplifier operates as a class AB amplifier during the track following operation.

114. (new) The driver of claim 112, wherein the transistor operates as a saturated bore transistor during the seek operation.

115. (new) The driver of claim 112, wherein the amplifier is turned off during the seek operation.

116. (new) The driver of claim 112, wherein the transistor is turned off during the track following operation.

117. (new) The driver of claim 112, wherein the coils provide opposing rotational forces in opposite rotational directions during the track following operation.

118. (new) The driver of claim 112, wherein the coils provide additive rotational forces in the same rotational direction during the seek operation.

119. (new) The driver of claim 112, wherein the coil current is divided between the first and second coils during the seek operation such that about one-half the coil current flows through the first coil and about one-half the coil current flows through the second coil.

120. (new) The driver of claim 112, wherein the transistor provides the coil current without using the integrated error current in response to the seek operation, and the transistor provides the coil current using the integrated error current in response to a retract operation.

121. (new) The driver of claim 112, wherein the amplifier is coupled to the first coil by a first terminal, the amplifier is coupled to the second coil by a second terminal, the transistor is coupled to the center tap by a third terminal, and an interface between the driver and the voice coil motor consists of the first, second and third terminals.

122. (new) In a disk drive that includes a head, a disk, a microprocessor, a driver and a voice coil motor, wherein the head reads from and writes to the disk, the microprocessor provides a command current to the driver, the driver provides a coil current to the voice coil motor in response to the command current, the voice coil motor radially positions the head
5 relative to the disk in response to the coil current, the coil current flows through a coil in the voice coil motor, the coil includes first and second coils and a center tap, and the first and second coils are coupled to one another at the center tap, the driver comprising:

a sensor that provides a sense current by sensing the coil current;

a comparator that provides an error current by determining a difference between the
10 command current and the sense current;

an integrator that provides an integrated error current by integrating the error current;

an amplifier that provides the coil current through the first and second coils in series while the center tap floats by amplifying the integrated error current in response to a track following operation, wherein the amplifier includes first and second amplifiers, the first amplifier
15 is coupled to the first coil, the second amplifier is coupled to the second coil, the first amplifier is coupled to the second coil and the center tap through the first coil, and the second amplifier is coupled to the first coil and the center tap through the second coil; and

a transistor that provides the coil current through the center tap independently of the comparator and the integrator such that the coil current is divided between and flows in parallel
20 through the first and second coils in response to a seek operation.

123. (new) The driver of claim 122, wherein the amplifier operates as a class AB amplifier during the track following operation and is turned off during the seek operation, and the transistor operates as a saturated bore transistor during the seek operation and is turned off during the track following operation.

124. (new) The driver of claim 122, wherein the coils provide opposing rotational forces in opposite rotational directions during the track following operation and provide additive rotational forces in the same rotational direction during the seek operation.

125. (new) The driver of claim 122, wherein the transistor provides the coil current using the integrated error current in response to a retract operation in which the head is retracted from the disk and loaded on a ramp.

126. (new) The driver of claim 122, wherein the first amplifier is coupled to the first coil by a first terminal, the second amplifier is coupled to the second coil by a second terminal, the transistor is coupled to the center tap by a third terminal, and an interface between the driver and the voice coil motor consists of the first, second and third terminals.

127. (new) In a disk drive that includes a head, a disk, a microprocessor, a driver and a voice coil motor, wherein the head reads from and writes to the disk, the microprocessor provides a command current to the driver, the driver provides a coil current to the voice coil motor in response to the command current, the voice coil motor radially positions the head relative to the disk in response to the coil current, the coil current flows through a coil in the voice coil motor, the coil includes first and second coils and a center tap, and the first and second coils are coupled to one another at the center tap, the driver comprising:

a sensor resistor that provides a sense voltage by sensing the coil current;

a transconductance amplifier that provides a sense current in response to the sense voltage;

a comparator that provides an error current by determining a difference between the command current and the sense current;

an integrator that provides an integrated error current by integrating the error current using a capacitor;

an amplifier that provides the coil current through the first and second coils in series while the center tap floats by amplifying the integrated error current in response to a track following operation, wherein the amplifier includes first and second amplifiers, the first amplifier is coupled to the first coil, the second amplifier is coupled to the second coil, the first amplifier is coupled to the second coil and the center tap through the first coil, and the second amplifier is coupled to the first coil and the center tap through the second coil; and

a transistor that provides the coil current through the center tap independently of the comparator and the integrator such that the coil current is divided between and flows in parallel through the first and second coils in response to a seek operation.

128. (new) The driver of claim 127, wherein the amplifier operates as a class AB amplifier during the track following operation and is turned off during the seek operation, and the transistor operates as a saturated bore transistor during the seek operation and is turned off during the track following operation.

129. (new) The driver of claim 127, wherein the coils provide opposing rotational forces in opposite rotational directions during the track following operation and provide additive rotational forces in the same rotational direction during the seek operation.

130. (new) The driver of claim 127, wherein the transistor provides the coil current using the integrated error current in response to a retract operation in which the head is retracted from the disk and loaded on a ramp.

131. (new) The driver of claim 127, wherein the first amplifier is coupled to the first coil by a first terminal, the second amplifier is coupled to the second coil by a second terminal, the transistor is coupled to the center tap by a third terminal, and an interface between the driver and the voice coil motor consists of the first, second and third terminals.

132. (new) In a disk drive that includes a head, a disk, a microprocessor, a driver and a voice coil motor, wherein the head reads from and writes to the disk, the microprocessor provides a command current to the driver, the driver provides a coil current to the voice coil motor in response to the command current, the voice coil motor radially positions the head
5 relative to the disk in response to the coil current, the coil current flows through a coil in the

voice coil motor, the coil includes first and second coils and a center tap, and the first and second coils are coupled to one another at the center tap, the driver comprising:

a sensor that provides a sense current by sensing the coil current;

a comparator that provides an error current by determining a difference between the

10 command current and the sense current;

an integrator that provides an integrated error current by integrating the error current;

an amplifier that provides the coil current through the first and second coils in series

while the center tap floats by amplifying the integrated error current in response to a track

following operation, wherein the amplifier includes first and second amplifiers, the first amplifier

15 is coupled to the first coil, the second amplifier is coupled to the second coil, the first amplifier is

coupled to the second coil and the center tap through the first coil, and the second amplifier is

coupled to the first coil and the center tap through the second coil; and

a transistor that provides the coil current through the center tap independently of the

comparator and the integrator such that the coil current is divided between and flows in parallel

20 through the first and second coils in response to a seek operation;

wherein the driver includes an integrated circuit chip, and the comparator, the amplifier

and the transistor are internal to the chip.

133. (new) The driver of claim 132, wherein the amplifier operates as a class AB amplifier during the track following operation and is turned off during the seek operation, and the transistor operates as a saturated bore transistor during the seek operation and is turned off during the track following operation.

134. (new) The driver of claim 132, wherein the coils provide opposing rotational forces in opposite rotational directions during the track following operation and provide additive rotational forces in the same rotational direction during the seek operation.

135. (new) The driver of claim 132, wherein the transistor provides the coil current using the integrated error current in response to a retract operation in which the head is retracted from the disk and loaded on a ramp.

136. (new) The driver of claim 132, wherein the first amplifier is coupled to the first coil by a first terminal, the second amplifier is coupled to the second coil by a second terminal, the transistor is coupled to the center tap by a third terminal, and an interface between the driver and the voice coil motor consists of the first, second and third terminals.

137. (new) In a disk drive that includes a head, a disk, a microprocessor, a driver and a voice coil motor, wherein the head reads from and writes to the disk, the microprocessor provides a command current to the driver, the driver provides a coil current to the voice coil motor in response to the command current, the voice coil motor radially positions the head relative to the disk in response to the coil current, the coil current flows through a coil in the voice coil motor, the coil includes first and second coils and a center tap, and the first and second coils are coupled to one another at the center tap, the driver comprising:

a sensor resistor that provides a sense voltage by sensing the coil current;

a transconductance amplifier that provides a sense current in response to the sense

10 voltage;

a comparator that provides an error current by determining a difference between the command current and the sense current;

an integrator that provides an integrated error current by integrating the error current using a capacitor;

15 an amplifier that provides the coil current through the first and second coils in series while the center tap floats by amplifying the integrated error current in response to a track following operation, wherein the amplifier includes first and second amplifiers, the first amplifier is coupled to the first coil, the second amplifier is coupled to the second coil, the first amplifier is coupled to the second coil and the center tap through the first coil, and the second amplifier is
20 coupled to the first coil and the center tap through the second coil; and

a transistor that provides the coil current through the center tap independently of the comparator and the integrator such that the coil current is divided between and flows in parallel through the first and second coils in response to a seek operation;

wherein the driver includes an integrated circuit chip, the transconductance amplifier, the
25 comparator, the amplifier and the transistor are internal to the chip and the sense resistor and the capacitor are external to the chip.

138. (new) The driver of claim 137, wherein the amplifier operates as a class AB amplifier during the track following operation and is turned off during the seek operation, and the transistor operates as a saturated bore transistor during the seek operation and is turned off during the track following operation.

139. (new) The driver of claim 137, wherein the coils provide opposing rotational forces in opposite rotational directions during the track following operation and provide additive rotational forces in the same rotational direction during the seek operation.

140. (new) The driver of claim 137, wherein the transistor provides the coil current using the integrated error current in response to a retract operation in which the head is retracted from the disk and loaded on a ramp.

141. (new) The driver of claim 137, wherein the first amplifier is coupled to the first coil by a first terminal, the second amplifier is coupled to the second coil by a second terminal, the transistor is coupled to the center tap by a third terminal, and an interface between the driver and the voice coil motor consists of the first, second and third terminals.